

Technical training.
Product information.

G12 Passive Safety Systems



BMW Service

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General information

Symbols used

The following symbol is used in this document to facilitate better comprehension or to draw attention to very important information:



Contains important safety information and information that needs to be observed strictly in order to guarantee the smooth operation of the system.

Information status and national-market versions

BMW Group vehicles meet the requirements of the highest safety and quality standards. Changes in requirements for environmental protection, customer benefits and design render necessary continuous development of systems and components. Consequently, there may be discrepancies between the contents of this document and the vehicles available in the training course.

This document basically relates to the European version of left hand drive vehicles. Some operating elements or components are arranged differently in right-hand drive vehicles than shown in the graphics in this document. Further differences may arise as the result of the equipment specification in specific markets or countries.

Additional sources of information

Further information on the individual topics can be found in the following:

- Owner's Handbook
- Integrated Service Technical Application.

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The information contained in this document forms an integral part of the technical training of the BMW Group and is intended for the trainer and participants in the seminar. Refer to the latest relevant information systems of the BMW Group for any changes/additions to the technical data.

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G12 Passive Safety Systems

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G12 Passive Safety Systems

1. Introduction

1.1. The hidden protector

The passive safety system of the G12 is based on the objectives and characteristics of current BMW models. The passive safety system fulfils all legislative requirements worldwide.

The restraint systems ensure that the risk of injury is reduced.

A 5th generation Advanced Crash Safety Module (ACSM) is used as the central airbag control unit for the passive safety system in the G12. In contrast to other series, with the passive safety system of the G12 the central sensor system is integrated in the ACSM control unit and not in the Integrated Chassis Management (ICM). This is possible with the G12 as the Crash Safety Module (ACSM) is located in the center of vehicle.

The ACSM 5 of the G12 is a bus user in the FlexRay. The sensor data of the central sensor system which was previously provided by the Integrated Chassis Management (ICM) can be transmitted directly by the Crash Safety Module (ACSM) via FlexRay to the Dynamic Stability Control (DSC).

G12 Passive Safety Systems

2. System Overview

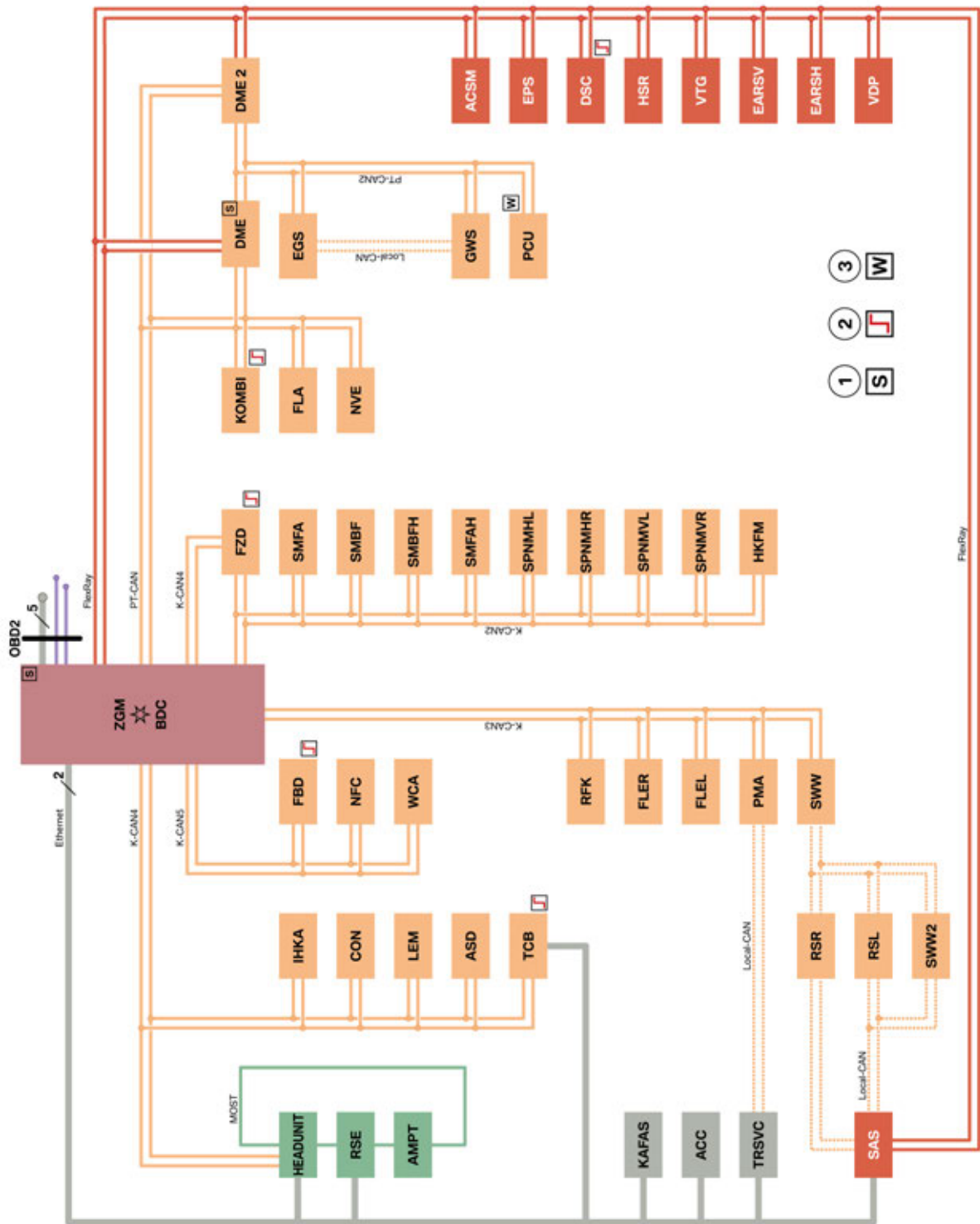
The following bus overview outlines the vehicle electrical system structure of the G12 and the incorporation of the Crash Safety Module (ACSM) in the FlexRay.

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2. System Overview

2.1. System wiring diagrams

2.1.1. Bus overview



G12 bus overview

G12 Passive Safety Systems

2. System Overview

Index	Explanation
ACC	Active cruise control
ACSM	Crash Safety Module
AMPT	Top Hi-Fi amplifier
ASD	Active Sound Design
BDC	Body Domain Controller
CON	Controller
DME	Digital Motor Electronics
DME2	Digital Engine Electronics 2
DSC	Dynamic Stability Control
EARSH	Electric active roll stabilization rear
EARSV	Electric active roll stabilization front
EGS	Electronic transmission control
EPS	Electromechanical Power Steering
FLA	High-beam assistant
FLER	Frontal Light Electronics Right
FLEL	Frontal Light Electronics Left
FZD	Roof function center
GWS	Gear selector
HEADUNIT	Head unit
HKFM	Tailgate function module
HSR	Rear axle slip angle control
IHKA	Integrated automatic heating / air conditioning
KAFAS	Camera-based driver support systems
KOMBI	Instrument panel
LEM	Light effect manager
NFC	Near Field Communication
NVE	Night Vision Electronics
PCU	Power Control Unit
PMA	Parking manoeuvring assistant
RFK	Reversing camera
RSE	Rear Seat Entertainment
RSL	Radar sensor left (avoidance assistant)
RSR	Radar sensor right (avoidance assistant)
SAS	Optional equipment system
SMBF	Seat module, passenger

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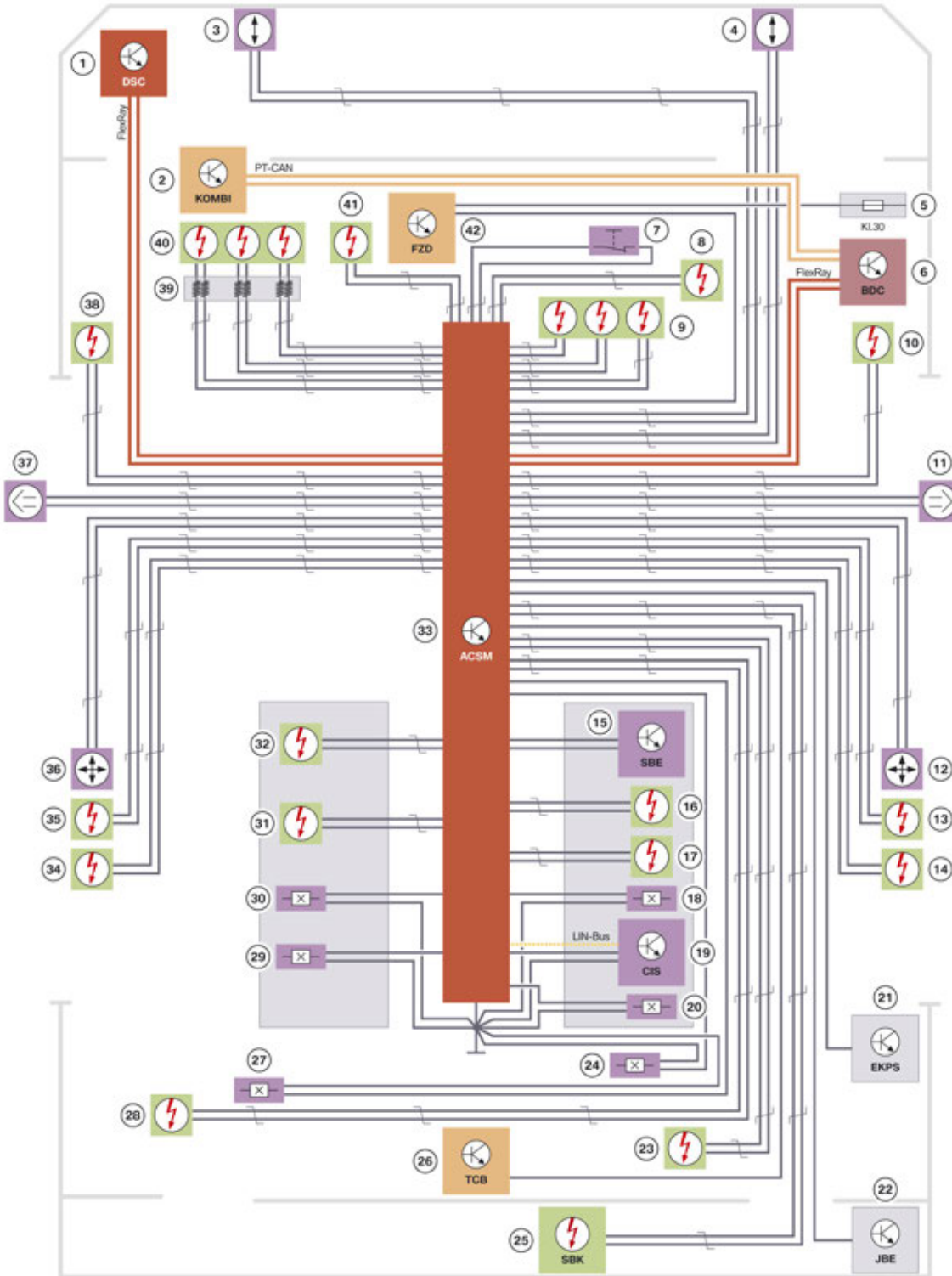
2. System Overview

Index	Explanation
SMBFH	Seat module, passenger, rear
SMFA	Seat module, driver
SMFAH	Seat module, driver, rear
SPNMHL	Seat pneumatics module back left
SPNMHR	Seat pneumatics module back right
SPNMVL	Seat pneumatics module front left
SPNMVR	Seat pneumatics module front right
SWW	Lane change warning (master)
SWW2	Lane change warning (slave)
TCB	Telematic Communication Box
TR SVC	Top rear side view camera
VDP	Vertical dynamics platform
VTG	Transfer case
WCA	Wireless charging tray
ZGM	Central gateway module
1	Start-up node control units for starting and synchronizing the FlexRay bus system
2	Control units with wake-up authorisation
3	Control units also connected at terminal 15WUP

G12 Passive Safety Systems

2. System Overview

2.1.2. System wiring diagram



TE14-1915

G12 System wiring diagram

G12 Passive Safety Systems

2. System Overview

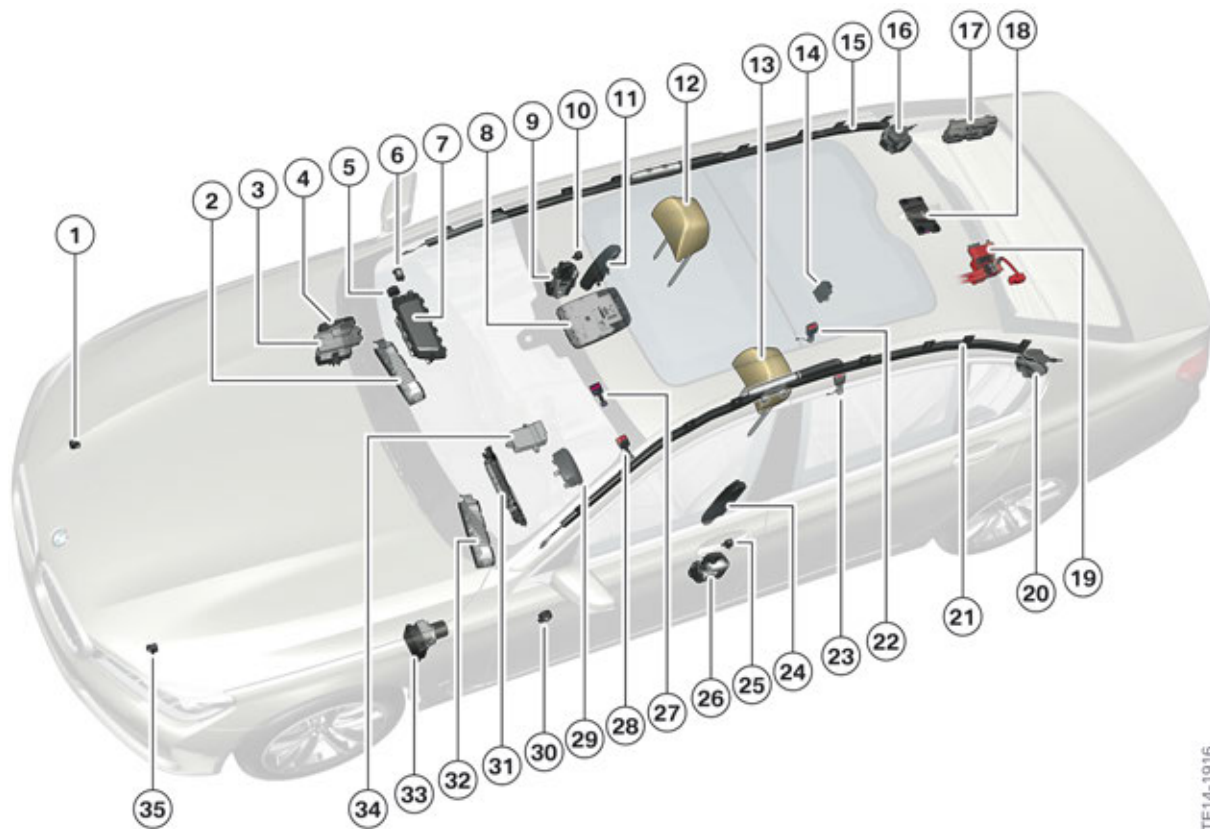
Index	Explanation
1	Dynamic Stability Control (DSC)
2	Instrument cluster (KOMBI)
3	Airbag front sensor, left
4	Airbag front sensor, right
5	Fuses for power distribution box, front right
6	Body Domain Controller (BDC)
7	Switch for front passenger airbag deactivation (only Korea)
8	Knee airbag, front passenger
9	Front passenger airbag
10	Head airbag, right
11	Airbag sensor, door, right (pressure)
12	Acceleration sensor, B-pillar on right
13	Adaptive belt force limiter, passenger's side
14	Belt tensioner, front passenger
15	Seat occupancy mat (only Korea)
16	Crash-active headrest, front passenger
17	Side airbag, front passenger
18	Seat-position sensor, front right
19	Seat occupancy mat, CIS mat
20	Seat belt buckle switch, front passenger
21	Electronic fuel pump control
22	Junction box electronics (JBE)
23	Belt tensioner, front passenger
24	Seat belt buckle switch, rear right (only vehicles with comfort seats in rear passenger compartment (OE 460) or Executive Lounge (OE 7GZ))
25	Safety battery terminal (SBK)
26	Telematic Communication Box 2 (TCB2)
27	Seat belt buckle switch, rear left (only vehicles with comfort seats in rear passenger compartment (OE 460) or Executive Lounge (OE 7GZ))
28	Belt tensioner, driver
29	Seat belt buckle switch, driver
30	Seat-position sensor, front left
31	Side airbag, driver's side
32	Crash-active headrest, driver
33	Crash Safety Module (ACSM)
34	Belt tensioner, driver

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2. System Overview

Index	Explanation
35	Adaptive belt force limiter, driver's side
36	Acceleration sensor, B-pillar on left
37	Airbag sensor, door, left (pressure)
38	Head airbag, left
39	Clock spring
40	Driver's airbag
41	Knee airbag, driver
42	Roof function center (FZD)

2.2. System overview



G12 system overview

TE14-1916

G12 Passive Safety Systems

2. System Overview

Index	Explanation
1	Airbag front sensor, right
2	Knee airbag, front passenger
3	Power distribution box, front right
4	Body Domain Controller (BDC)
5	Switch for front passenger airbag deactivation (Not for US)
6	Airbag sensor, door, right (pressure)
7	Front passenger airbag
8	Roof function center (FZD)
9	Automatic tensioner, front passenger
10	Acceleration sensor, B-pillar on right
11	Side airbag, front passenger
12	Crash-active headrest, front passenger
13	Crash-active headrest, driver
14	Electronic fuel pump control
15	Head airbag, left
16	Seat belt, rear right
17	Junction box electronics (JBE)
18	Telematic Communication Box 2 (TCB2)
19	Safety battery terminal (SBK)
20	Seat belt, rear left
21	Head airbag, right
22	Seat belt buckle switch, rear right (only vehicles with comfort seats in rear passenger compartment (OE 460) or Executive Lounge Seating (OE 7GZ))
23	Seat belt buckle switch, rear left (only vehicles with comfort seats in rear passenger compartment (OE 460) or Executive Lounge Seating (OE 7GZ))
24	Side airbag, driver's side
25	Acceleration sensor, B-pillar on left
26	Automatic tensioner, driver
27	Seat belt buckle switch, front passenger
28	Seat belt buckle switch, driver
29	Driver's airbag
30	Airbag sensor, door, left (pressure)
31	Instrument cluster (KOMBI)

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2. System Overview

Index	Explanation
32	Knee airbag, driver
33	Dynamic Stability Control (DSC)
34	Crash Safety Module (ACSM)
35	Airbag front sensor, left

G12 Passive Safety Systems

3. Functions

3.1. Functions of Crash Safety Module

The function of the Crash Safety Module is to permanently evaluate all sensor signals in order to identify a crash situation. Based on the sensor signals and their evaluation, the Crash Safety Module (ACSM) identifies the direction of the crash and the severity of the impact.

The Crash Safety Module (ACSM) evaluates the sensor information and then initiates the relevant measures for selective activation of the necessary restraint systems.

At the same time the Crash Safety Module (ACSM) monitors the system itself and indicates when it is ready for operation by switching off the airbag indicator light.

If an error occurs during operation this is stored in a fault memory. The fault memory can be read out for diagnosis purposes.

If a crash situation is detected, a crash message is sent to the other bus users in the data bus network as notification. The relevant control units respond to this signal by executing their own activities according to the severity of the crash.

The activities include:

- Opening the central locking system
- Activating the hazard warning flasher
- Switching on the interior light
- Making an emergency call

An additional function of the Crash Safety Module is the acoustic seat belt warning that reminds the driver using visual and acoustic signals to fasten his seat belt. With help of a seat belt buckle switch it is determined whether the driver has fastened his seat belt. Furthermore, for vehicles in the US version the position of the driver and the front passenger seat is monitored.

The functions of the Crash Safety Module generally belong to one of the following areas:

- Crash-relevant functions
- System monitoring functions
- Additional convenience functions

3.2. Crash-relevant functions

The Crash Safety Module must fulfil the following crash-relevant functions:

- Evaluating the sensor signals
- Impact detection
- Determining actuators to be activated
- Specifying the trigger time and trigger sequence
- Activation of the ignition circuit output stages

G12 Passive Safety Systems

3. Functions

- Sending the crash message to all bus users
- Crash documentation
- Emergency call function

3.2.1. Evaluating the sensor signals

The sensors serve to identify and verify front-end, side-on and rear-end crashes and also as roll-over detection.

The sensors are located in the Crash Safety Module (ACSM) or are directly connected to the Crash Safety Module, where their signals are evaluated and processed.

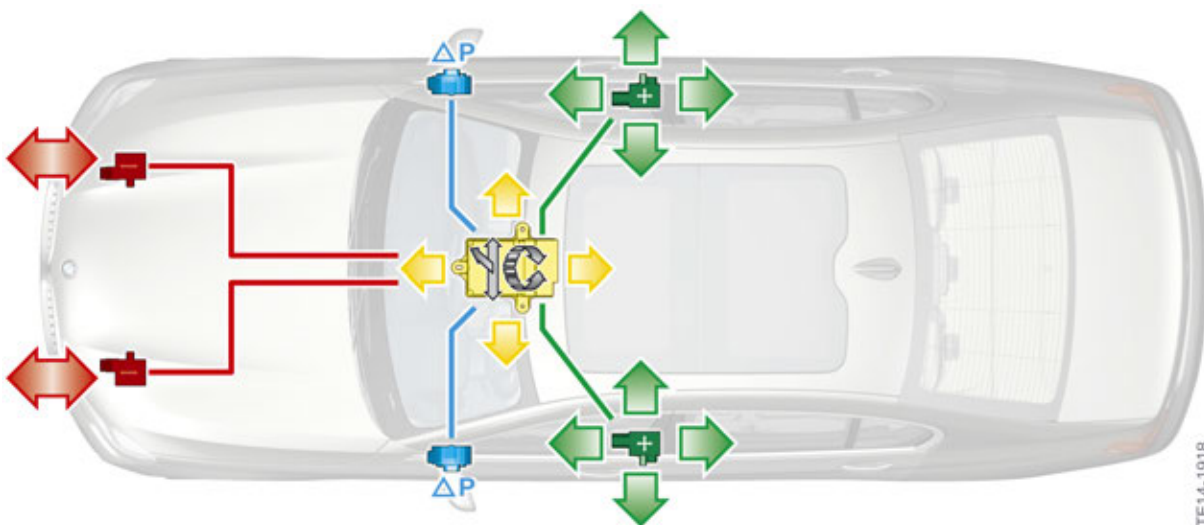
3.2.2. Impact detection

The US version of the vehicles is equipped with the following sensors:

- one lateral and one longitudinal acceleration sensor in the B-pillars (green).
- one airbag sensor to monitor the pressure in each of the front doors (blue).
- one lateral and one longitudinal acceleration sensor in the ACSM (yellow).
- one roll rate sensor in the ACSM (yellow).
- one vertical acceleration sensor in the ACSM (yellow).
- one front sensor on each of the engine supports (red).

The airbag sensors in the doors assist with the identification of a side-on crash.

The airbag front sensors assist with the identification of a head-on crash and its corresponding severity.



G12 sensors

TE14-1918

G12 Passive Safety Systems

3. Functions

3.2.3. Trigger time and trigger sequence

The Crash Safety Module uses the values transmitted by the sensors to determine the direction and severity of the crash.

In the case of a head-on crash, correspondingly high acceleration values must be detected for example by the longitudinal acceleration sensors in the rear side panels and by the longitudinal acceleration sensor in the Crash Safety Module (ACSM). An algorithm determines the severity and direction of the crash based on the accelerations. This information is used to assist calculation of the activation times and sequence in which the restraint systems are activated.

A possible imminent rollover is also detected and the appropriate protection systems are energized.

3.2.4. Activation of the ignition circuit output stages

The Crash Safety Module is supplied by the power distribution box on the rear right using terminal 30B. The Crash Safety Module (ACSM) is in offline mode with terminal 30B. This means that it is active on the data bus and can perform all diagnostic functions.

Activation of the ignition circuits is blocked and is available as of the "Residing" driving condition once the system self-test is complete. The Crash Safety Module (ACSM) is also ready for ignition in the "Driving" driving condition.

The ignition capacitors are recharged via a switching controller. These ignition capacitors make the firing energy available in the event of a crash. If the voltage supply is interrupted during a crash, the ignition capacitors serve briefly as an energy reserve.

The ignition circuit output stages consist of a high-side and a low-side power switch. The high-side power switch connects the ignition voltage, while the low-side power switch connects to the ground. The ignition circuit output stages are controlled by a microcontroller.

The high-side and low-side power switches also serve to check the ignition circuits during the system self-test.

3.2.5. Sending the crash message

In the event of a collision involving activation of the restraint systems, the Crash Safety Module (ACSM) sends a crash signal to the bus users in the data bus network.

The Telematic Communication Box 2 (TCB2) is actuated in parallel via a direct single-wire connection. The Telematic Communication Box 2 (TCB2) is the follow-on telematics control unit to the Telematic Communication Box (TCB). The TCB2 acts as a data modem in the vehicle and has one or two data aeriels as well as a connection to an emergency aerial. This can be used to establish a telephone connection via the connected vehicle microphone even if the vehicle has rolled over. A built-in SIM card inside the control unit makes these emergency calls possible.

G12 Passive Safety Systems

3. Functions

As a result, the respective control units perform the following functions depending on the crash severity:

Function	Control unit
Switch off electric fuel pump	Digital Motor Electronics (DME) via electronic fuel pump control (EKPS)
Release central locking system	Body Domain Controller (BDC)
Switch on hazard warning flashers	Body Domain Controller (BDC)
Switch on interior light	Body Domain Controller (BDC)
Transmit emergency call	Telematic Communication Box 2 (TCB2)

3.2.6. Crash documentation

In the event of a collision where one or more actuators are activated, a crash entry is stored in a non-erasable memory. After five crash entries, a non-erasable fault code entry is stored together with the information that the five crash messages have been saved. The airbag indicator light also lights up continuously.



The five crash entries could also be stored during the course of an accident. Each crash entry is assigned a system time. The control unit remains ignitable even after five crash entries. The crash entries cannot be erased and serve the purpose of subsequent device diagnosis. A maximum of five crash entries can be saved. The control unit must then be replaced.

3.2.7. Emergency call function

The emergency call functions are country-specific and are available to customers in countries with ConnectedDrive Services infrastructure. An emergency call requires an active SIM card in the Telematic Communication Box 2 (TCB2) and an available mobile phone network.

The emergency call button is connected directly to the Telematic Communication Box 2 (TCB2).

The manual emergency call allows the driver to request assistance in the event of a medical emergency.

3.3. System monitoring functions

The Crash Safety Module has the following system monitoring functions:

- System self-test (pre-drive check).
- Display of system operability.
- Cyclic monitoring.
- Fault display and fault storage.
- Output of faults (diagnosis).

G12 Passive Safety Systems

3. Functions

- Acoustic and visual seat belt warning.
- Deactivation of the front passenger airbag and side airbag on the passenger's side in European version vehicles (only vehicles with (OE 5DA)).
- Deactivation of the front passenger airbag and side airbag and knee airbag on the passenger's side and the knee airbag in the US version of the vehicles.

3.3.1. System self test

The Crash Safety Module (ACSM) performs a system self-test after a terminal change has been made as of the "Residing" driving condition. The airbag indicator light is activated for roughly five seconds during the system self test.

Once the system self-test is complete and no faults have been identified, the airbag indicator light goes out and the system is operational.

3.3.2. Display of system operability

The airbag indicator light in the instrument panel goes out to indicate that the Crash Safety Module is ready for operation.

3.3.3. Cyclic monitoring

Once the system self-test has been successfully concluded and the system is ready for operation, a cyclic monitoring procedure is performed for fault monitoring purposes. This cyclical monitoring serves the internal diagnosis of the control unit and overall airbag system. Cyclical monitoring takes place continuously as of the "Residing" driving condition. It is also continued after a terminal change has been made as of the "Driving" driving condition.

3.3.4. Fault display and fault storage

The Crash Safety Module (ACSM) has a non-volatile fault memory. The airbag indicator light lights up to indicate a fault entry.

Events such as the activation of an airbag or retractor tensioner are also stored in the fault memory.



If the fault memory contains the entry that the restraint system has been activated, this only means the ignited restraint system is not available for further activation and not that it malfunctioned during the crash.

3.3.5. Output of faults (diagnosis)

The fault memory can be read out via the diagnostic interface with the assistance of the Integrated Service Technical Application ISTA in the BMW diagnosis system. After rectifying the faults or after replacing activated components, the fault memory can be cleared with the diagnosis command "Clear fault memory".

G12 Passive Safety Systems

3. Functions

3.3.6. Acoustic and visual seat belt warning

An acoustic and visual seat belt warning is a standard feature of all vehicles equipped with the Crash Safety Module (ACSM). The Crash Safety Module (ACSM) records whether or not the driver or front passenger have fastened their seat belts. If they have not, an acoustic and visual warning is output to remind them to fasten their seatbelts. Both seat belt buckle switches are monitored separately. Depending on the national-market version and optional equipment, seat belt buckle switches are also installed in the rear passenger compartment and a seat belt warning is issued accordingly for the rear seat passengers.

3.3.7. Deactivating the airbag

CIS mat

Provision is made in US versions of the vehicles for the airbag to be deactivated automatically in order to satisfy the regulations of the National Highway Traffic Safety Administration NHTSA. When the child seats listed in the regulation are occupied by a child this must lead to deactivation of the airbag.

To do so, a seat occupancy mat is used on the front passenger seat for the purpose of occupancy detection and classification of occupants in the front passenger seat. A Capacitive Interior Sensing mat (CIS mat) is used in the G12.

The CIS mat is made up of two elements: A sensor wire, which runs parallel to the seat heating in the seat cushion, and an evaluation unit. The CIS mat measures the capacity and ohmic resistance between the sensor wire (anode) and the vehicle ground (cathode) at a frequency of 120 kHz. The CIS mat determines from the change in capacity and resistance whether the front passenger seat is occupied by an adult or a child in a child seat.

The deactivation of the front passenger airbag, the side airbag and knee airbag on the passenger's side is signalled by the indicator lamp for front passenger airbag deactivation.

The indicator lamp for front passenger airbag deactivation in the roof function center lights up if a child seat with child (for example a child restraint system that has been tested in accordance with the NHTSA regulations and is holding a small child on the front passenger seat) was detected or if the front passenger seat is unoccupied.

3.4. Active protection

The standard equipment of the G12 already contains the Active Protection safety package (OE 5AL).

The Active Protection safety package (OE 5AL) comprises the following three functionally independent subsystems:

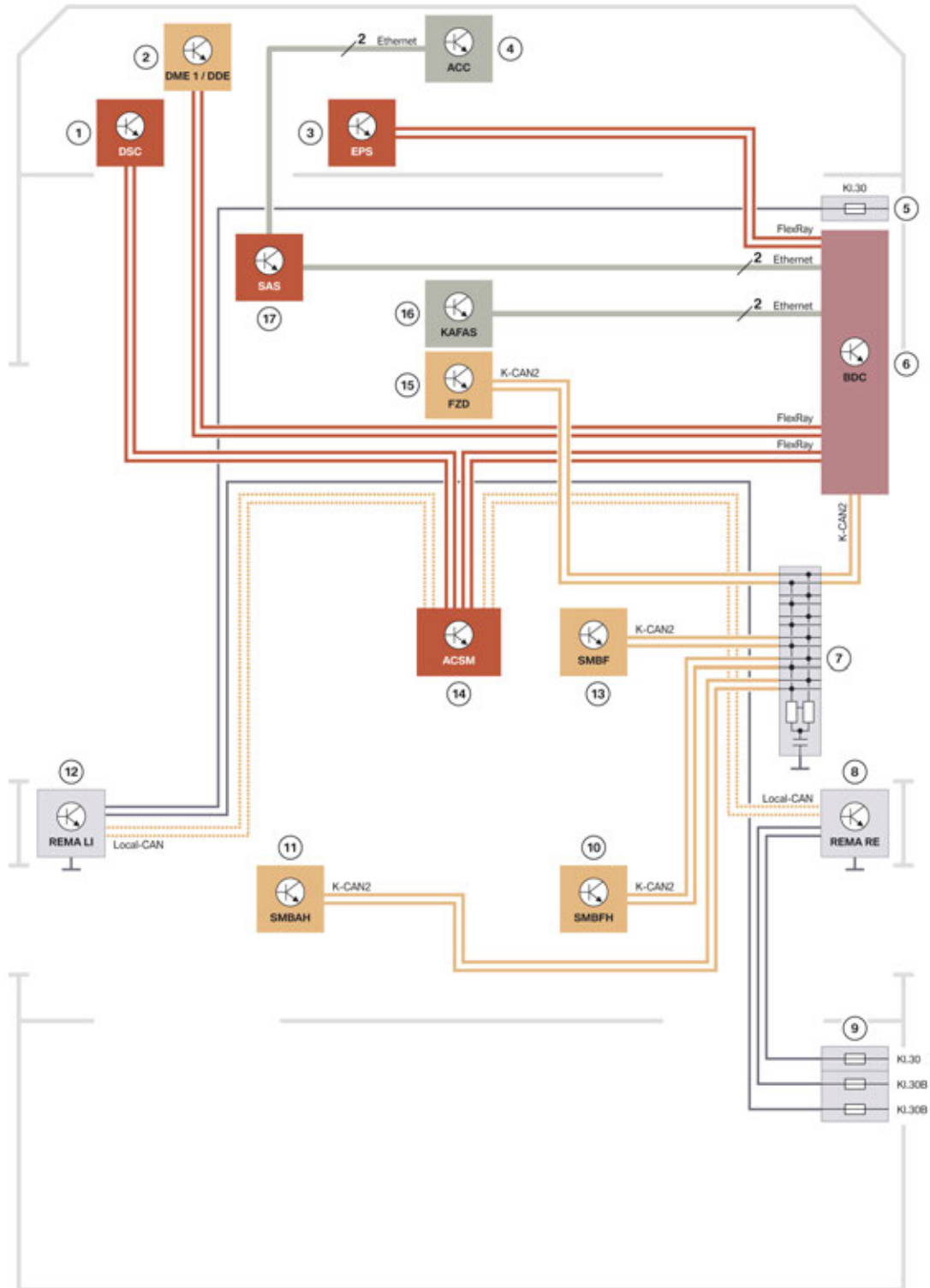
- PreCrash
- PostCrash
- Alertness assistant

The Active Protection safety package (OE 5AL) increases the safety of the occupants through preventative measures in the event of critical driving situations (PreCrash) and through measures after a crash (PostCrash). The attention assist monitors the driving style of the driver during a trip and encourages the driver to take breaks if necessary.

G12 Passive Safety Systems

3. Functions

3.4.1. System wiring diagram for Active Protection



G12 system wiring diagram for Active Protection

TE15-0060

G12 Passive Safety Systems

3. Functions

Index	Explanation
1	Dynamic Stability Control (DSC)
2	Digital Motor Electronics (DME)
3	Electronic Power Steering (EPS)
4	Radar sensor for active cruise control (ACC)
5	Fuse in power distribution box, front right
6	Body Domain Controller (BDC)
7	CAN terminator
8	Reversible motor-driven reel, right (REMABF)
9	Fuse in power distribution box, rear right
10	Front passenger seat module, rear (SMBFH)
11	Driver's seat module, rear (SMFAH)
12	Reversible motor-driven reel, left (REMAFA)
13	Front passenger seat module, (SMBF)
14	Crash Safety Module (ACSM)
15	Roof function center (FZD)
16	Camera-based driver support systems (KAFAS)
17	Control unit for optional equipment system SAS

3.4.2. PreCrash

The PreCrash subsystem introduces preventative protective measures for the occupants in known critical driving situations which may lead to an accident.

Identification of critical driving situations

Critical driving situations are identified with help of the inertial sensor system installed in the vehicle. Critical driving situations include:

- Emergency braking initiated
- Strong understeer
- Strong oversteer
- Rollover of the vehicle

For vehicles with the optional Driving Assistance Plus (Package ZDB) which includes Active Driving Assistant (OE 5AS) and Active Driving Assistant Plus (OE 5AT) imminent collisions that have been detected with help of the radar sensor system and KAFAS stereo camera. For the PreCrash identification, separate thresholds to the collision warning thresholds are made available by the KAFAS or radar sensor system for activating the PreCrash functions.

G12 Passive Safety Systems

3. Functions

Basic PreCrash functions

The standard equipment of the G12 already contains the Active Protection safety package (OE 5AL) and offers the following basic ranges of functions:

Convenience function

- When the seat belt is fastened, the front seat belts are automatically pre-tensioned once when driving starts.

Safety functions

In detected situations that are critical for driving dynamics (for example own emergency braking, strong understeer, skidding) the following individual functions are activated according to need:

- Automatic pre-tensioning of front seat belts
- Automatic closing of windows up to a gap

Enhanced PreCrash functions

Different ranges of functions are implemented with the PreCrash subsystem depending on the equipment.

The "Enhanced PreCrash functions" include additional ranges of functions on top of the basic functions.

The table below provides an overview of the individual ranges of functions for the PreCrash subsystem and how these are linked to the optional equipment:

	Scope of function	Optional equipment*
"Extension" of PreCrash functions (only with additional optional equipment)	Automatic closing of the glass sunroof Positioning the front passenger backrest Positioning the rear seat backrests	Option 402 Option 456 Option 460
"Extension" of detected PreCrash situations (only with additional optional equipment)	Additional need-based activation of PreCrash functions in the case of: Detected, unavoidable collisions with vehicles travelling in front or stationary vehicles (requires OE with collision alert) Automatic emergency braking of the vehicle in the event of imminent collisions above a specific deceleration threshold Detected, unavoidable rear-end collisions caused by colliding vehicles	OE 5AS or OE 5AT

G12 Passive Safety Systems

3. Functions

*Explanation of optional equipment codes:

- OE 402 Panoramic electric glass moonroof
- OE 456 Multi-contour seats
- OE 460 Rear comfort seats
- OE 5AS Active Driving Assistant
- OE 5AT Active Driving Assistant Plus

3.4.3. PostCrash

The PostCrash subfunction includes the automatic braking function after an accident, which brakes the vehicle to a standstill in certain accident situations without intervention from the driver. The risk of another collision can thus be reduced. The driver may oversteer the automatic braking after a crash by pressing the brake pedal or accelerator pedal.

The automatic braking after a crash is activated if a crash with sufficient severity has been identified in the Crash Safety Module (ACSM). The Crash Safety Module (ACSM) then sends a signal to the electronic fuel pump control unit (EKPS) to switch off the fuel pump. This same signal is evaluated by the DSC control unit. The DSC control unit then brakes the vehicle with help of the DSC pump and brings it to a standstill.

The DSC generates a setpoint deceleration of 5 m/s² for braking. The setpoint deceleration is only achieved if road conditions permit this. During automatic braking the accelerator pedal and brake pedal are monitored. The automatic braking is interrupted if the accelerator pedal is pressed or if the brake pedal is pressed for a longer period by the driver. Pressing the accelerator pedal only causes the braking process to stop. Acceleration of the vehicle is not possible as the fuel pump is switched off.

Also during automatic braking the ABS prevents the wheels from blocking and the DSC stabilizes the vehicle. If the DSC is in DSC OFF mode during automatic braking, a forced activation of the DSC is effected.

Approx. 1.5 seconds after reaching standstill, the brake is automatically released and the vehicle must be secured against rolling away.

If a crash is detected, which leads to activation of the safety battery terminal, then automatic braking cannot be activated as the DSC pump is no longer supplied with power.

Automatic braking is not activated under the following conditions:

- The DSC has failed before the crash.
- The ABS has failed before the crash.
- The brake fluid level is too low.

If these faults occur during or after the crash, the control is led to the end as these faults are then interpreted as consequences of the crash.

G12 Passive Safety Systems

4. System Components

4.1. Crash Safety Module

In the G12 the Crash Safety Module (ACSM) is located centrally in the vehicle under the center console between the two front seats. The central sensor system is integrated in the Crash Safety Module (ACSM).



G12 Crash Safety Module (ACSM)

4.2. Sensors and switches

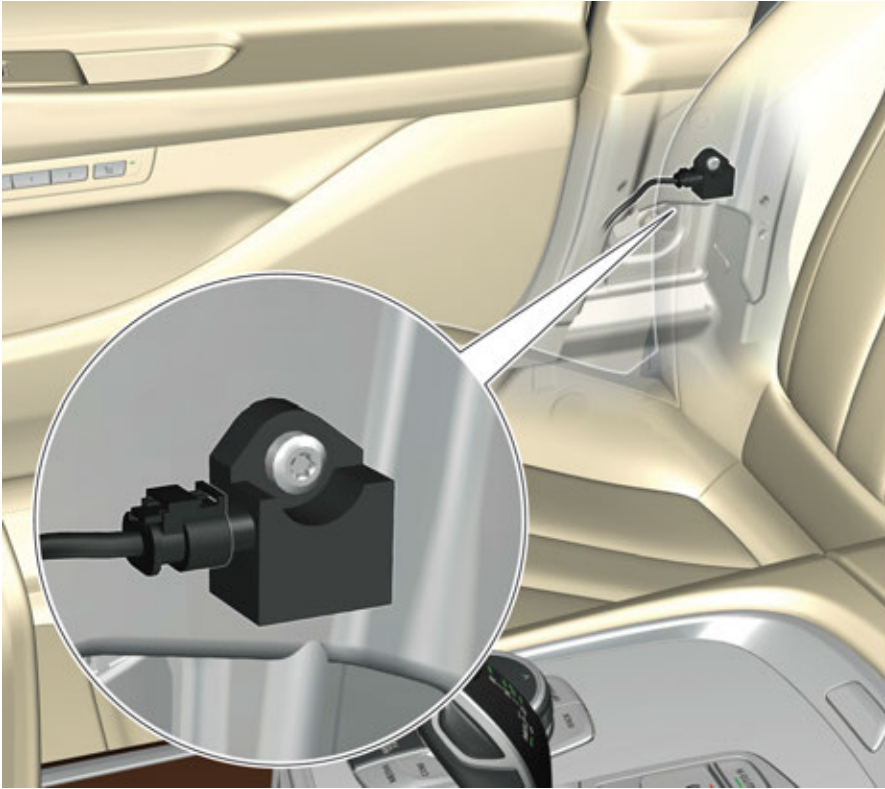
4.2.1. Lateral and longitudinal acceleration sensor

The lateral and longitudinal acceleration sensors assist with the identification of head-on crashes, side-on crashes and rear-end crashes.

The airbag sensor consists of a longitudinal acceleration sensor and a lateral acceleration sensor. The acceleration sensors measure the positive and negative acceleration in the X and Y direction. The resulting value from the X and Y signal is decisive in identifying the direction of the crash. The airbag sensors assist with the identification of head-on, side-on and rear-end crashes. The airbag sensors on the left and right are of identical design and are allocated by way of mechanical encoding during installation.

G12 Passive Safety Systems

4. System Components



G12 lateral and longitudinal acceleration sensor

4.2.2. Door pressure sensor

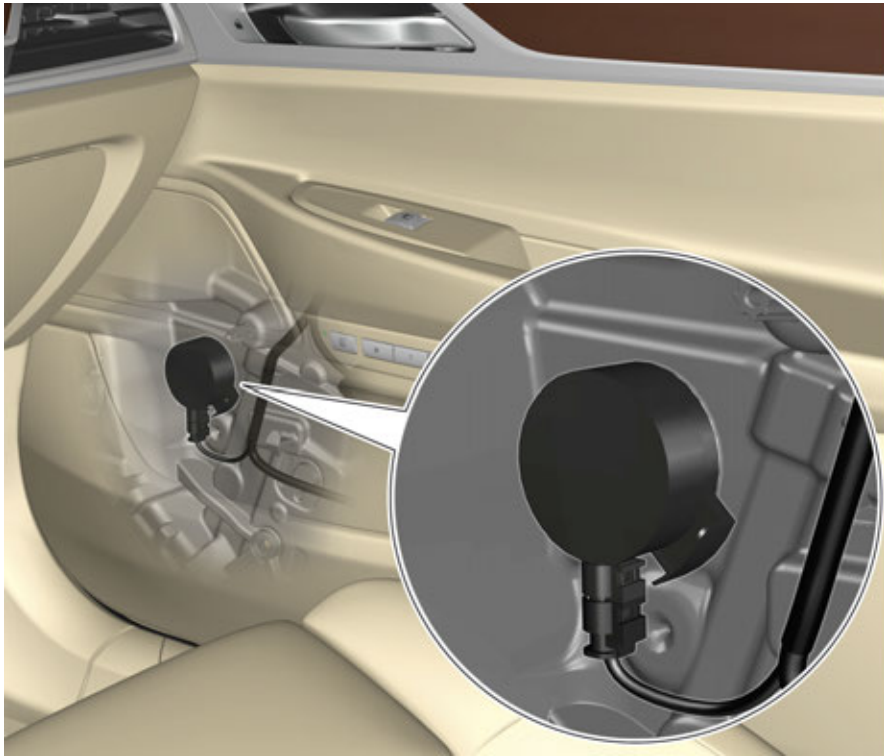
In the G12 pressure sensors are installed in the driver's door and front passenger door. The pressure sensors in the doors are now no longer attached with a bolt as was previously the case, but instead are screwed into the bracket (inner door panel) and the electrical connections and plug connections can only be connected once the relevant sensors have been installed.

Side crashes are identified with the assistance of the airbag sensors. In addition to the lateral acceleration values that are present, the pressure in the door cavity also increases in the event of a side-on crash.

The airbag sensors in the doors are used to verify the plausibility of the acceleration signals from the B-pillar airbag sensors and the Crash Safety Module (ACSM) when a side-on crash is detected. The airbag sensors are situated in the inner panel of the doors and measure the pressure increase in the event of a side-on collision. In the event of a side-on collision at the door the outer skin is pushed inwards. The door interior is reduced in size and the inner pressure increases. This pressure change is measured by the airbag sensors. The airbag sensor also includes electronics, in addition to the pressure sensor, that digitise the pressure readings and transmit them cyclically to the Crash Safety Module (ACSM). The data transfer is effected analogue to the airbag sensors in the B-pillars. The pressure readings are evaluated in the Crash Safety Module (ACSM).

G12 Passive Safety Systems

4. System Components



G12 door airbag sensor (pressure)

4.2.3. Airbag front sensor

Two front sensors are installed in the front area. The measured values are forwarded to the Crash Safety Module (ACSM) where they are evaluated.

The airbag front sensors on the left and right assist with the identification of a head-on crash.

The sensors deliver additional information to the Crash Safety Module (ACSM) on the characteristics and severity of the collision. Each sensor contains an acceleration sensor for recording the deceleration, signal processing technology and electronics for data transfer. The measured values are sent in the form of a message to the Crash Safety Module (ACSM) and are used in the calculation of the algorithm.

G12 Passive Safety Systems

4. System Components



G12 airbag front sensor

4.2.4. Sensors in the ACSM

In the G12, the central sensor system is integrated in the Crash Safety Module (ACSM). The Crash Safety Module (ACSM) contains a longitudinal and lateral acceleration sensor, a vertical acceleration sensor and a roll rate sensor for impact detection. The Crash Safety Module (ACSM) also includes a longitudinal and lateral acceleration sensor and a yaw sensor for the driving dynamics control.

The sensor data for impact detection is evaluated in the Crash Safety Module (ACSM) and helps to identify side-on, rear-end or head-on crashes and assists with roll-over detection. The sensor data not yet evaluated for the driving dynamics control is sent to the DSC control unit via FlexRay where it is processed.

G12 Passive Safety Systems

4. System Components



G12 Crash Safety Module (ACSM)

4.2.5. CIS mat

The capacitive interior sensing mat (CIS mat) is fitted in the front passenger seat. The CIS mat detects whether the front passenger seat is occupied by an adult or a child in a child seat. The deactivation of the front passenger airbag, the side airbag and the knee airbag on the passenger's side is signalled by the indicator light for front passenger airbag deactivation.

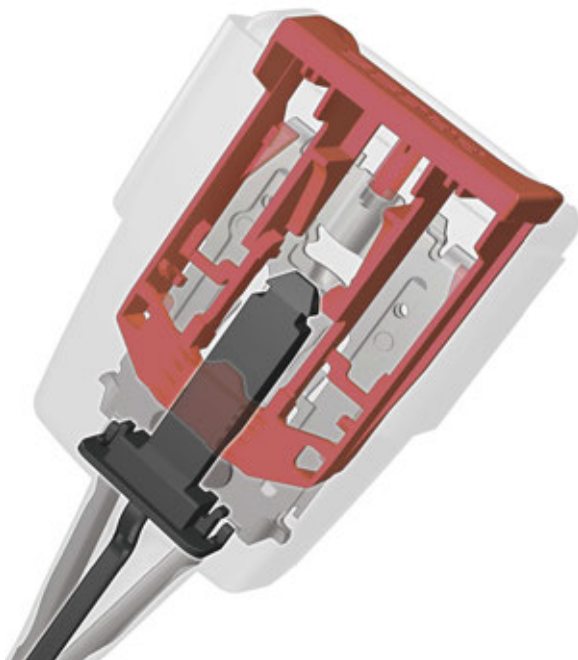
4.2.6. Seat belt buckle switch

The seat belt buckle switches are located in the seat belt buckles of the driver and front passenger seat.

The seat belt buckle switch detects whether the seat belt buckle tongue is in the seat belt buckle. The Crash Safety Module (ACSM) supplies power to the sensors and performs the evaluation. As of driving readiness, the seat belt buckle switch is permanently monitored and used for the visual and acoustic seat belt warning and also to determine which restraint systems are to be triggered.

G12 Passive Safety Systems

4. System Components



TE14-1928

G12 seat belt buckle switch

4.2.7. Emergency call button

The emergency call button is located in the roof function center.



TE14-1929

G12 roof function center (FZD) with emergency call button

Index	Explanation
1	Emergency call button

G12 Passive Safety Systems

4. System Components

4.2.8. Seat-position sensors

In accordance with the US legal requirement (FMVSS208), a height identification for the person in the driver and front passenger seat must be effected. This height identification is effected via the adjustment travel of the forward/back seat adjustment. In US-version vehicles, the exact position is identified using the seat-position sensors for the driver and front passenger seats.

The job of the seat-position detector is to distinguish between a relatively small person and a person of normal height within the lengthways adjustment range of the seat. This detection is another technical feature aimed at increasing the safety of the occupants. The deployment of the two airbag stages is then adjusted to the driver's/front passenger's seat position.

The seat-position detector takes the form of a 2-wire hall effect sensor and is supplied with power via the Crash Safety Module (ACSM). The current level of the seat-position sensor changes depending on the seat position.

4.3. Actuators

4.3.1. Overview

The following actuators are installed in the G12:

- Two-stage driver's airbag
- Two-stage front passenger airbag
- Knee airbag on front left and right
- Head airbag on left and right
- Side airbag on front left and right
- Belt tensioner with adaptive force limiter
- Safety battery terminal

In addition, the following indicator lights inform the vehicle occupants about the condition of the safety systems:

- Airbag indicator light.
- Seat belt warning light.
- Indicator lamp for front passenger airbag deactivation.

The familiar three-point seat belts are used as the seat belt systems for all seats in the G12.

G12 Passive Safety Systems

4. System Components



G12 seat belt

Index	Explanation
1	Seat belt buckle
2	Belt tensioner

4.3.2. Driver's airbag

The purpose of the driver's airbag is to reduce the risk of injury to the driver in combination with the seat belt when a front-end crash occurs. The driver's airbag is located in the steering wheel impact plate. The driver's airbag is equipped with a gas generator.

A two-stage gas generator is installed which can be used to activate the stages at short or long time differences, depending on the severity of the crash detected and taking into consideration the seat position.

In addition, the driver's airbag features an active vent valve.

G12 Passive Safety Systems

4. System Components



G12 driver's airbag

Index	Explanation
1	Ignition squib, level 1
2	Ignition squib, level 2

4.3.3. Front passenger airbag

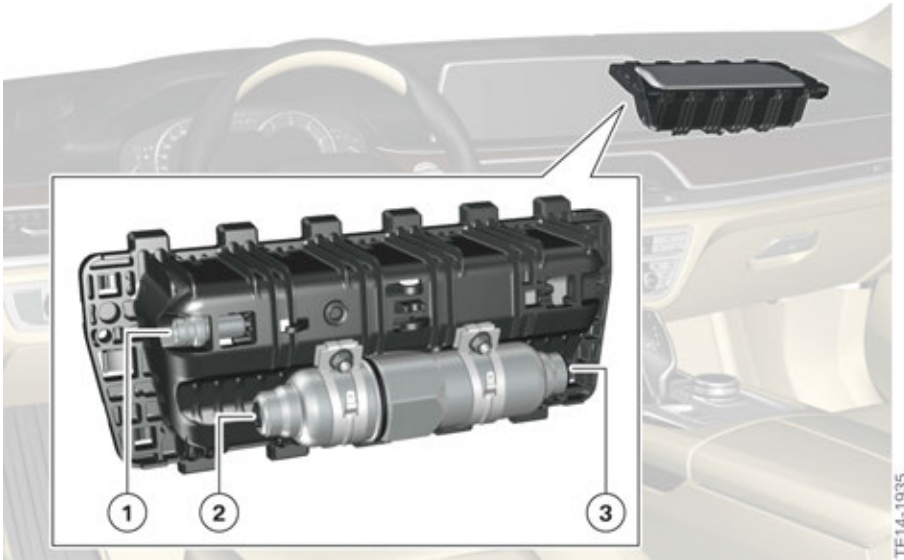
The purpose of the front passenger airbag is to reduce the risk of accident to the front passenger in the event of a front-end crash. The front passenger airbag is located in the dashboard. When the front passenger airbag expands, the dashboard tears open at defined points.

A two-stage gas generator is installed which can be used to activate the stages at short or long time differences, depending on the severity of the crash detected and taking into consideration the seat position.

The front passenger airbag features an active vent valve.

G12 Passive Safety Systems

4. System Components



G12 front passenger airbag

Index	Explanation
1	Ignition squib for active vent valve
2	Ignition squib, level 1
3	Ignition squib, level 2

4.3.4. Knee airbag

The US standards (laws) contain requirements on the passive restraint of occupants (without seatbelt). This is why in the US version of the vehicles a knee airbag is also required on the driver's side and passenger's side to control the forwards displacement of the occupant(s) in the event of a head-on crash.



G12 knee airbags in US version of vehicles

G12 Passive Safety Systems

4. System Components

4.3.5. Head airbag

Head airbags are installed in the G12 to protect the occupants' heads in the event of a side collision.

The head airbag extends from the A-pillar to the C-pillar and covers the entire area of the side windows. It expands between the occupants and side structure.

System features:

- Extended covered area across all front and rear side windows.
- Protection of occupants from glass splinters.
- Covered area for different-sized occupants optimized.



G12 head airbag

4.3.6. Side airbag

As with all current BMW models, the side airbag at the front ignites out of the front seat backrest.

The side airbags and gas generators are accommodated in a plastic housing, the airbag module. This is installed in the front seat backrest and is concealed by the seat cover.

If activated, the side airbag emerges outwards from the backrest frame and spreads between the side structure and occupant.



It is important to ensure that no additional seat covers are fitted as they would greatly impair the function of the side airbag, or even immobilize it altogether.

G12 Passive Safety Systems

4. System Components



G12 side airbag

Index	Explanation
1	Side airbag

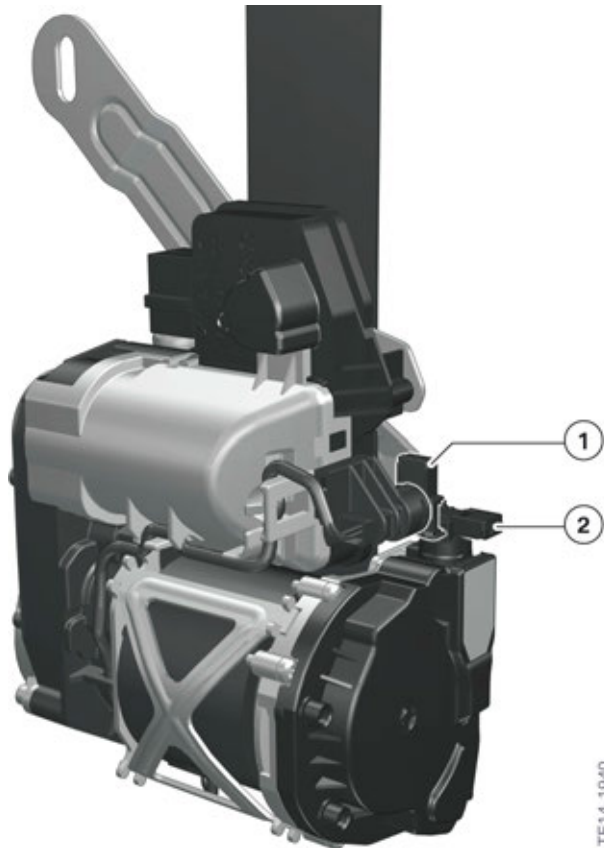
4.3.7. Automatic tensioner with adaptive force limiter

An automatic reel with adaptive force limiter for the driver and front passenger is installed in the G12. With the aid of a gas generator, there is a changeover from a high to a low power level during the impact, in order to reduce the seat belt restraining forces.

When optimally harmonised with the airbag, it ensures the kinetic energy acting on the occupants is more evenly dissipated for the duration of the crash. Thus lower occupant stress values are achieved.

G12 Passive Safety Systems

4. System Components



G12 retractor tensioner with adaptive force limiter

Index	Explanation
1	Connection of ignition squib, belt tensioner
2	Connection of ignition squib, adaptive force limiter

4.3.8. Active head restraints, front

The active head restraint is used in the new BMW 7 Series in conjunction with the multifunction seat. This is a head restraint with a pyrotechnic actuator that optimizes the distance and height of the headrest in relation to the head if a rear-end collision of sufficient force occurs. This reduces the load on the cervical vertebrae in the event of a rear-end collision. The head restraint is activated early, even prior to backwards displacement of the occupant's head.

The active head restraint reduces the load in the cervical vertebrae in the event of a rear-end collision. For the vehicle occupants therefore, correct adjustment of the head restraint and the distance of the head from the head restraint is of crucial importance.

In the event of a rear-end collision, the active head restraint reduces the distance between the head and the head restraint before the occupants are displaced backwards. This reduces the danger of injury to the cervical vertebrae, even if a minor accident occurs.

G12 Passive Safety Systems

4. System Components

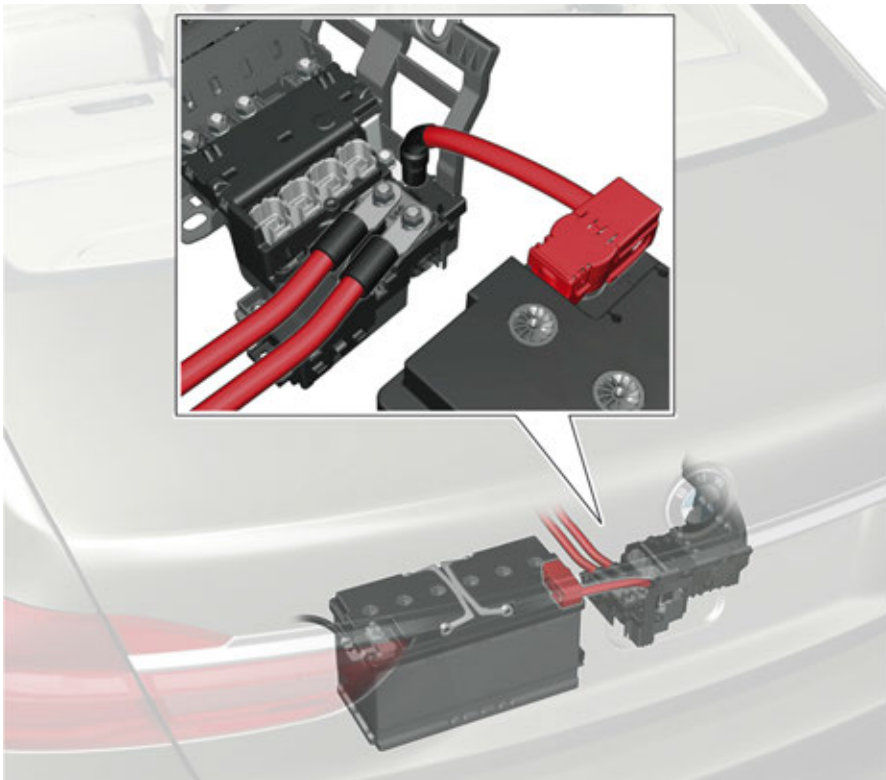


Seat or head restraint covers and/or accessories that could impair the protective effect must not be mounted on the head restraints.

4.3.9. Safety battery terminal

The safety battery terminal (SBK) is triggered at different thresholds when the Crash Safety Module (ACSM) detects a head-on, side-on or rear-end crash of sufficient severity.

Even though the safety battery terminal (SBK) has been disconnected, a voltage supply to all safety-relevant consumers such as hazard warning lights, interior light, airbag and telephone (including emergency call) is ensured.



G12 safety battery terminal (SBK)

4.3.10. Airbag indicator light

The airbag indicator light is located on the instrument panel. The airbag indicator light lights up and then goes out during the pre-drive check to signal readiness of the Crash Safety Module (ACSM) and passive safety systems. The airbag indicator light is controlled via a message on the FlexRay from the Crash Safety Module (ACSM) via the Body Domain Controller (BDC) to the instrument cluster. The instrument cluster receives a message cyclically. If the message remains off, the airbag indicator light is activated.

G12 Passive Safety Systems

4. System Components



G12 airbag indicator light

4.3.11. Seat belt warning light

A visual and audible warning is issued if the seat belt is not fastened or is unbuckled during a trip.



G12 seat belt warning light

4.3.12. Indicator lamp for front passenger airbag deactivation

The indicator lamp for front passenger airbag deactivation is in the roof function center in the G12. The indicator lamp for front passenger airbag deactivation is automatically activated if the CIS mat detects a small child in a child seat or if the front passenger seat is unoccupied.

G12 Passive Safety Systems

4. System Components



G12 indicator lamp for front passenger airbag deactivation

Index	Explanation
1	Indicator lamp for front passenger airbag deactivation



Bayerische Motorenwerke Aktiengesellschaft
Qualifizierung und Training
Röntgenstraße 7
85716 Unterschleißheim, Germany